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编号： SP 44/2 - 19/77

题目： 1 090 MHz 频谱的问题和正确管理与仅在甚低高度层运行的无人航空器相关的 24 比特位航空器地址

要求： 见第 3 段

先生/女士：

1. 我荣幸地请你注意国际民航组织为确保航空监视系统继续安全和可靠运行而不断开展的举措，包括二次监视雷达（SSR）、自动相关监视广播（ADS-B）和机载避撞系统（ACAS）。

2. 正确和高效使用 1 090 MHz 的可用带宽和容量，是确保上述监视系统安全运行的关键因素。国际民航组织多个专家小组进行的研究，已查明在出现大量无人航空器（UA）而且这些无人航空器的 ADS-BOUT 发射器占用 1 090 MHz 并在甚低高度层运行时，对上述监视系统运行带来的某些问题和潜在的技术关切。由于认识到与这些可能对这一区域所有航空器造成不利影响的无人航空器相关的问题，国际民航组织制定了所附指导材料，以协助各国核验对于 1 090 MHz 的使用，且除非无人航空器达到某些标准，否则停止向其发放 24 比特位航空器地址（24-bit aircraft addresses）。

3. 为了确保上述系统提供的监视能力足以支持所必需的空中交通服务，我谨此鼓励贵国使用本信函附篇中的指导材料，以及其他相关规定。国际民航组织愿随时提供协助，以便利实施程序、指导和分享最佳做法。

顺致最崇高的敬意。

秘书长
柳 芳
2019 年 11 月 8 日

内附：

关于 1 090 MHz 频谱的问题和正确管理与无人航空器（UA）相关的 24 比特位航空器地址的指导（未经编辑版）（仅有英文）

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ATTACHMENT to State letter SP 44/2-19/77

GUIDANCE ON 1 090 MHZ SPECTRUM ISSUES AND PROPER MANAGEMENT OF 24-BIT AIRCRAFT ADDRESSES ASSOCIATED WITH UNMANNED AIRCRAFT (UA)

Note. — This document is an unedited advance version of an ICAO publication as approved in principle, by the Secretary General, which is made available for convenience. The final edited version will be included in the next amendment to the Aeronautical Surveillance Manual (Doc 9924), which will be published in due course.

1. Background

1.1 The frequencies 1 030 and 1 090 MHz, acting as a frequency pair, support several aeronautical surveillance systems including secondary surveillance radar (SSR), multilateration (MLAT), airborne collision avoidance systems (ACAS) and automatic dependent surveillance-broadcast (ADS-B). Aircraft are interrogated by ground SSR/MLAT (or other aircraft, in the case of ACAS) on 1 030 MHz and reply (or broadcast) on 1 090 MHz with information such as their position, altitude and velocity vector.

1.2 The increasing density of ground-based and on-board surveillance systems using the 1 030/1 090 MHz frequencies is currently raising concerns, especially in dense airspaces. Ultimately it may result in a reduction to the overall performance of ACAS as well as the SSR/MLAT and ADS-B systems. In addition, the increased usage of ADS-B OUT applications for safety of life services and potential future evolution of those applications, such as space-based ADS-B, have raised serious concerns of potential congestion at 1 090 MHz. To ensure continued safe operation for all aircraft, proper and efficient utilization of available bandwidth at 1 090 MHz is required. This may include, when necessary, limiting access to 1 090 MHz by certain users.

1.3 Furthermore, it is important to note that those aeronautical surveillance systems rely on a limited capacity 24-bit aircraft address scheme. The allocation of a 24-bit aircraft address and its correct configuration in aircraft is a key element for safe operation of aircraft and associated protocols used to support communication and surveillance systems.

1.4 As defined in Annex 10 — *Aeronautical Telecommunications*, Volume III — *Communication Systems*, aircraft addresses are allocated in blocks by ICAO to the State of Registry or to the common mark registering authority. Using its allocated block of addresses, the State of Registry or the common mark registering authority assigns an individual aircraft address to each suitably equipped aircraft entered on a national or international register.

1.5 It is essential for States to recognize that their allocated block of 24-bit aircraft addresses is a finite and valuable asset. There are only 16 777 214 aircraft addresses in total and many of those have already been allocated to States of Registry or common mark registering authorities. Aircraft traffic growth has been forecast to double in the next 15 years and to manage these addresses in a sustainable manner, States need to validate whether new aircraft address allocation requests by aircraft operators fit the conditions defined in Annex 10, Volume III.

2. Issues identified in relation to operation of unmanned aircraft

2.1 As described above, concerns are being raised about congestion of the 1 090 MHz frequency and shortage of 24-bit aircraft addresses. The rapid growth in the number of UA is making those concerns more severe.

2.2 *Exponential increase of the safety risk due to 1 090 MHz congestion*

2.2.1 A recent study indicates that large numbers of UA (one UA per 2 square kilometres) operating at low level (less than 500 feet above ground level) in a typical high-density terminal airspace (760 ADS B-equipped aircraft operating within a 200 NM radius and from ground level to FL180) can

interfere with ADS-B ground station reception of ADS-B reports when the transmit power of each UA is 1 watt or higher.

Note. — Some other studies indicate that even a low power (0.1W) transmission from large numbers of UA can reduce the coverage range of ADS-B.

2.2.2 All studies reviewed conclude that the operation of ADS-B OUT by a large number of UA raises a serious concern for the safety of other aircraft in the same airspace.

2.3 *Future depletion of 24-bit aircraft addresses*

2.3.1 The 24-bit aircraft address scheme was not designed for a very large number of aircraft. Some studies predict that based on the present growth of UA, there will be over a million such vehicles by 2025. Based on these current projections, it will be impossible to accommodate all UA in the current scheme.

2.3.2 In some situations UA may require a 24-bit aircraft address, for instance if the UA fly in controlled airspace or in proximity to traditional manned aircraft. States will need to evaluate such situations on a case-by-case basis when receiving a new aircraft address application from the UA community.

Note. — As described in the Manual on Remotely Piloted Aircraft Systems (RPAS) (Doc 10019), an aircraft which is intended to be operated with no pilot on board is classified as unmanned and an unmanned aircraft which is piloted from a remote pilot station is a remotely piloted aircraft (RPA) (refer to the following figure).

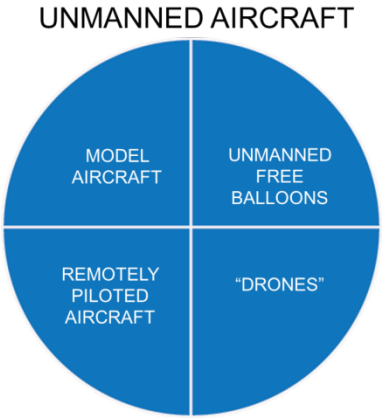

Figure 1-1 Unmanned aircraft

3. **Procedure to ensure proper utilization of 1 090 MHz and for non-allocation of (24-bit) aircraft address for UA**

3.1 There is increasing pressure to use 1 090 MHz Mode S or ADS-B OUT applications by UA. Given the large forecasted increase of UA and the fact that transmissions from their transponders or ADS-B OUT devices will impact the already congested use of 1 090 MHz by existing aeronautical surveillance and collision avoidance systems, States are urged to:

1) perform radio frequency spectrum analysis to analyse the degree of congestion of 1 090 MHz and, based on the outcome of this analysis, consider how 1 090 MHz ADS-B UA operations might impact the performance of the air navigation service provider (ANSP)-operated surveillance

systems in airspace of interest as well as the automatic collision avoidance systems on board aircraft operating in that airspace;

2) formulate the circumstances and define procedures to determine the potential requirement for 1 090 MHz ADS-B OUT equipage on UA in order to allow or prohibit such equipage as appropriate. During this process, States should consider:

   - the degree to which individual UA may or may not require air traffic services. For example, a UA operating in uncontrolled airspace may not be required to use ICAO-compliant aeronautical surveillance systems; and

   - the degree to which the operation of individual UA may or may not interoperate in the airspace with traditional manned aircraft. For example, if UA are not operating in proximity to traditional manned aircraft, then the use of ICAO-compliant aeronautical surveillance equipment by UA may not be justified.

3) in cases where UA are not required to equip with ICAO-compliant aeronautical surveillance equipment**,** States should not allocate 24-bit aircraft addresses.

Note.— 24-bit aircraft address allocation should be a part of the UA registration or operator approval process. For guidance material on reliable usage of 24-bit aircraft addresses, refer to Annex 10, Volume III and Doc 9924.

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